# Problem Statement

```
Predicting delivery time for the order.

Porter is India's Largest Marketplace for Intra-City Logistics. Leader in the country's $40 billion intra-city logistics market, Porter strives to improve the lives of 1,50,000+ driver-partners by providing them with consistent earning & independence. Currently, the company has serviced 5+ million customers

Porter works with a wide range of restaurants for delivering their items directly to the people.

Porter has a number of delivery partners available for delivering the food, from various restaurants and wants to get an estimated delivery time that it can provide the customers on the basis of what they are ordering, from where and also the delivery partners.
```

# Importing important libraries

In [154]:

```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import os
import sklearn
from sklearn.impute import SimpleImputer
import datetime
import seaborn as sns
%matplotlib inline
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
from math import sqrt
from sklearn.preprocessing import StandardScaler
```

# Data Loading

In [155]:

```python
df = pd.read_csv(r"dataset.csv")
df.head()
```

Out[155]:

| | market_id | created_at | actual_delivery_time | store_id | store_primary_category | order_protocol | total_items |
|---|---|---|---|---|---|---|---|
| **0** | 1.0 | 2015-02-06 22:24:17 | 2015-02-06 23:27:16 | df263d996281d984952c07998dc54358 | american | 1.0 | 4 |
| **1** | 2.0 | 2015-02-10 21:49:25 | 2015-02-10 22:56:29 | f0ade77b43923b38237db569b016ba25 | mexican | 2.0 | 1 |
| **2** | 3.0 | 2015-01-22 20:39:28 | 2015-01-22 21:09:09 | f0ade77b43923b38237db569b016ba25 | NaN | 1.0 | 1 |
| **3** | 3.0 | 2015-02-03 21:21:45 | 2015-02-03 22:13:00 | f0ade77b43923b38237db569b016ba25 | NaN | 1.0 | 6 |
| **4** | 3.0 | 2015-02-15 02:40:36 | 2015-02-15 03:20:26 | f0ade77b43923b38237db569b016ba25 | NaN | 1.0 | 3 |

### *Checking shape of the data*

In [76]:

```python
df.shape
```

Out[76]:

```
(197428, 14)
```

In [8]:

```
df.head(2)
```

Out[8]:

| | market_id | created_at | actual_delivery_time | store_id | store_primary_category | order_protocol | total_items |
|---|---|---|---|---|---|---|---|
| **0** | 1.0 | 2015-02-06 22:24:17 | 2015-02-06 23:27:16 | df263d996281d984952c07998dc54358 | american | 1.0 | 4 |
| **1** | 2.0 | 2015-02-10 21:49:25 | 2015-02-10 22:56:29 | f0ade77b43923b38237db569b016ba25 | mexican | 2.0 | 1 |

In [85]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 197428 entries, 0 to 197427
Data columns (total 14 columns):
 #   Column                    Non-Null Count   Dtype  
---  ------                    --------------   -----  
 0   market_id                 196441 non-null  float64
 1   created_at                197428 non-null  object 
 2   actual_delivery_time      197421 non-null  object 
 3   store_id                  197428 non-null  object 
 4   store_primary_category    192668 non-null  object 
 5   order_protocol            196433 non-null  float64
 6   total_items               197428 non-null  int64  
 7   subtotal                  197428 non-null  int64  
 8   num_distinct_items        197428 non-null  int64  
 9   min_item_price            197428 non-null  int64  
 10  max_item_price            197428 non-null  int64  
 11  total_onshift_partners    181166 non-null  float64
 12  total_busy_partners       181166 non-null  float64
 13  total_outstanding_orders  181166 non-null  float64
dtypes: float64(5), int64(5), object(4)
memory usage: 21.1+ MB
```

```
Checking missing values in the data
```

In [86]:

```
df.isna().sum()
```

Out[86]:

```
market_id                     987
created_at                      0
actual_delivery_time            7
store_id                        0
store_primary_category       4760
order_protocol                995
total_items                     0
subtotal                        0
num_distinct_items              0
min_item_price                  0
max_item_price                  0
total_onshift_partners      16262
total_busy_partners         16262
total_outstanding_orders    16262
dtype: int64
```

In [156]:

```python
percent_missing = df.isnull().sum() * 100 / len(df)
missing_value_df = pd.DataFrame({'column_name': df.columns,
                                 'percent_missing': percent_missing})
missing_value_df.sort_values('percent_missing', inplace=True,ascending=False)
missing_value_df
```

Out[156]:

| | column_name | percent_missing |
|---|---|---|
| **total_onshift_partners** | total_onshift_partners | 8.236927 |
| **total_busy_partners** | total_busy_partners | 8.236927 |
| **total_outstanding_orders** | total_outstanding_orders | 8.236927 |
| **store_primary_category** | store_primary_category | 2.411006 |
| **order_protocol** | order_protocol | 0.503981 |
| **market_id** | market_id | 0.499929 |
| **actual_delivery_time** | actual_delivery_time | 0.003546 |
| **created_at** | created_at | 0.000000 |
| **store_id** | store_id | 0.000000 |
| **total_items** | total_items | 0.000000 |
| **subtotal** | subtotal | 0.000000 |
| **num_distinct_items** | num_distinct_items | 0.000000 |
| **min_item_price** | min_item_price | 0.000000 |
| **max_item_price** | max_item_price | 0.000000 |

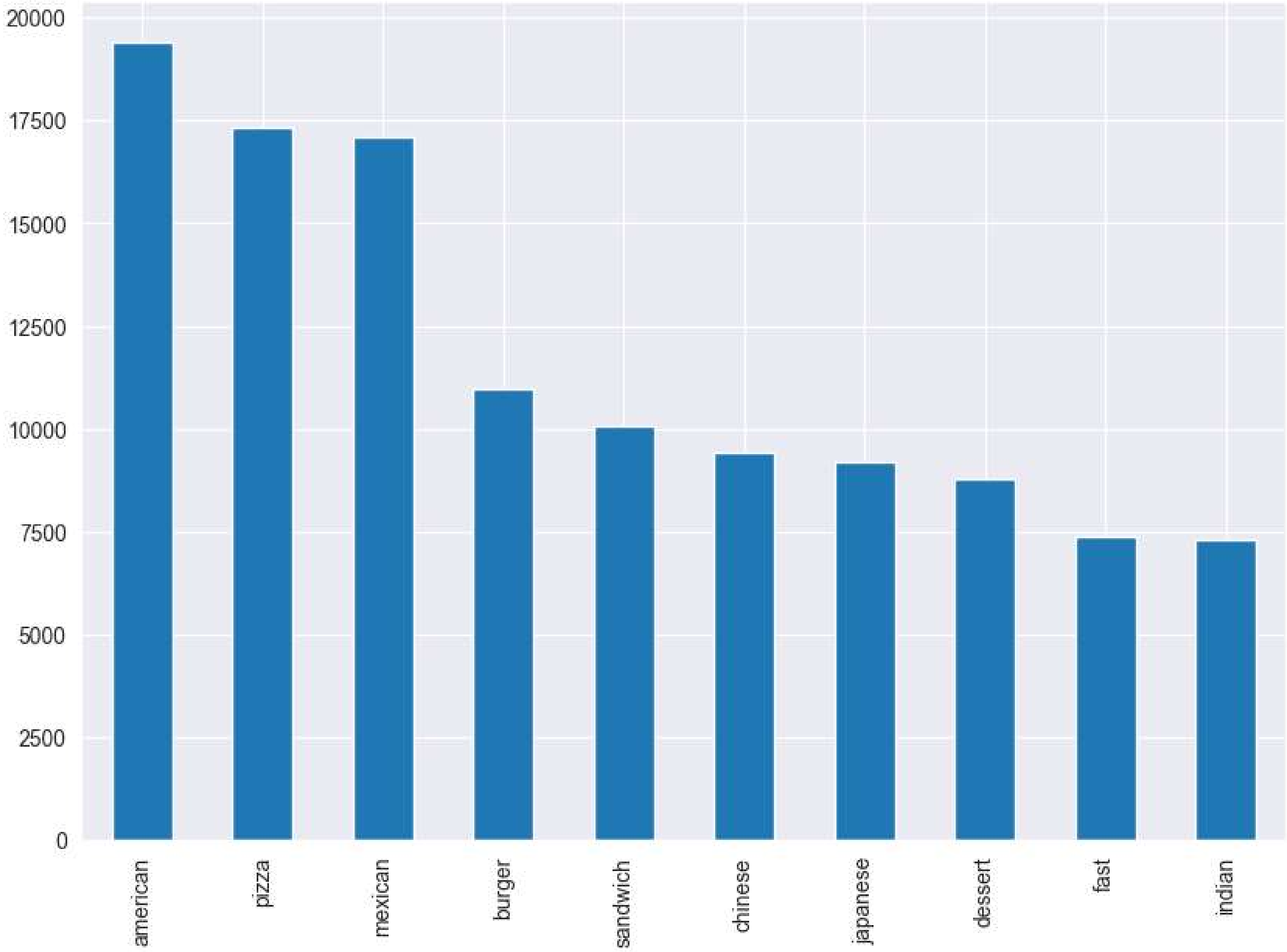
```
In this data six fields have missing values i.e 'market_id','store_primary_category','order_protocol',
'total_onshift_partners','total_busy_partners','total_outstanding_orders' last three categories have a lot of missing values.
```

In [80]:

```
sns.set_style('darkgrid')
country = df['store_primary_category'].value_counts().head(10)
fig, ax = plt.subplots(figsize=(10,7))
country.plot.bar(ax=ax)
```

Out[80]:

```
<AxesSubplot: >
```


20000
17500
15000
12500
10000
7500
5000
2500
0
american
pizza
mexican
burger
sandwich
chinese
japanese
dessert
fast
indian

In [19]:

```
df.store_primary_category.value_counts()
```

Out[19]:

```
american              19399
pizza                 17321
mexican               17099
burger                10958
sandwich              10060
                      ...
lebanese                  9
belgian                   2
indonesian                2
chocolate                 1
alcohol-plus-food         1
Name: store_primary_category, Length: 74, dtype: int64
```

In [88]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 197428 entries, 0 to 197427
Data columns (total 14 columns):
 #   Column                    Non-Null Count   Dtype
---  ------                    --------------   -----
 0   market_id                 196441 non-null  float64
 1   created_at                197428 non-null  datetime64[ns]
 2   actual_delivery_time      197421 non-null  datetime64[ns]
 3   store_id                  197428 non-null  object
 4   store_primary_category    192668 non-null  object
 5   order_protocol            196433 non-null  float64
 6   total_items               197428 non-null  int64
 7   subtotal                  197428 non-null  int64
 8   num_distinct_items        197428 non-null  int64
 9   min_item_price            197428 non-null  int64
 10  max_item_price            197428 non-null  int64
 11  total_onshift_partners    181166 non-null  float64
 12  total_busy_partners       181166 non-null  float64
 13  total_outstanding_orders  181166 non-null  float64
dtypes: datetime64[ns](2), float64(5), int64(5), object(2)
memory usage: 21.1+ MB
```

In [25]:

```
df.head(2)
```

Out[25]:

|  | market_id | created_at | actual_delivery_time | store_id | store_primary_category | order_protocol | total_items |
|---|---|---|---|---|---|---|---|
| **0** | 1.0 | 2015-02-06 22:24:17 | 2015-02-06 23:27:16 | df263d996281d984952c07998dc54358 | american | 1.0 | 4 |
| **1** | 2.0 | 2015-02-10 21:49:25 | 2015-02-10 22:56:29 | f0ade77b43923b38237db569b016ba25 | mexican | 2.0 | 1 |

In [26]:

```
df['market_id'].value_counts()
```

Out[26]:

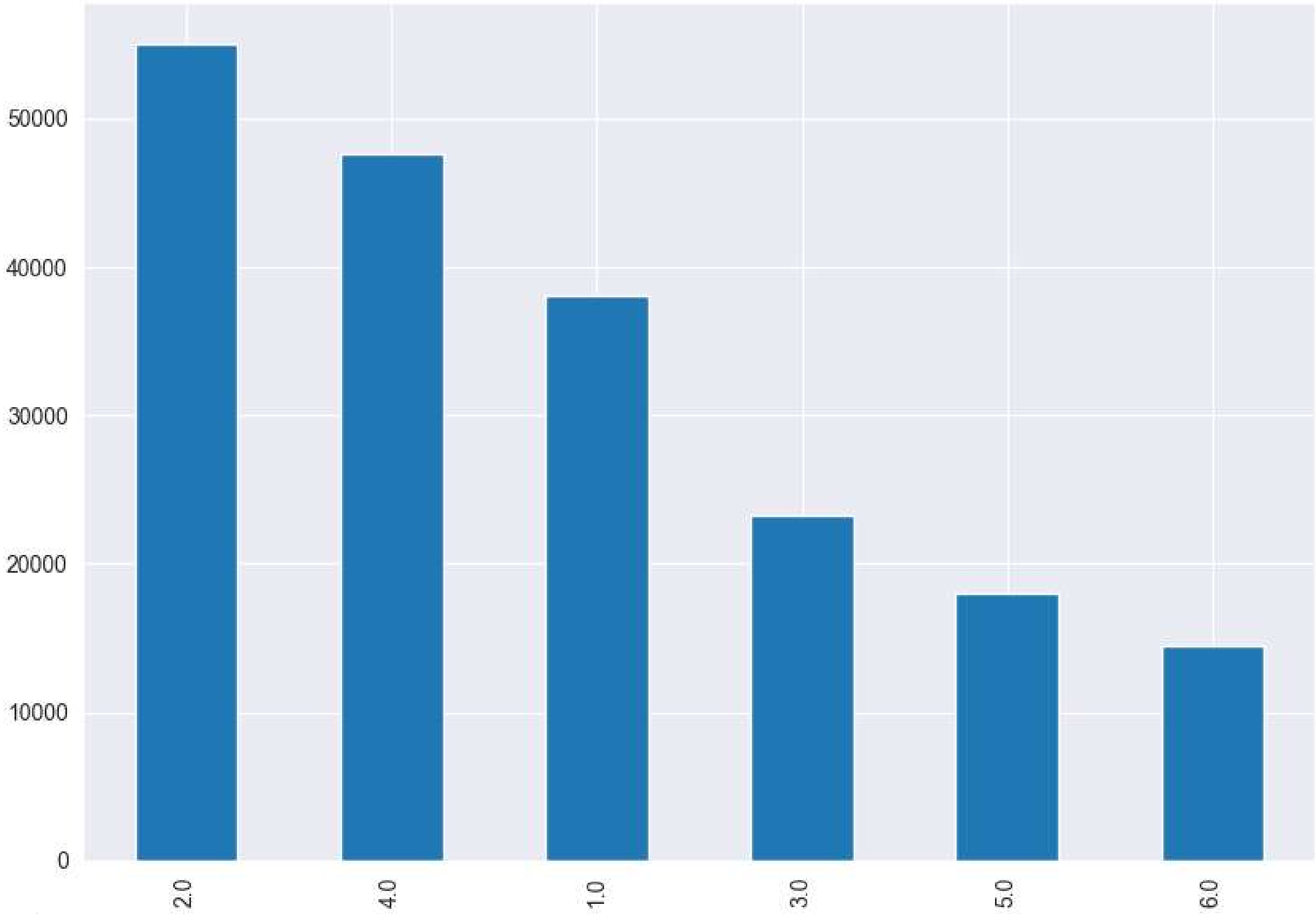
```
2.0    55058
4.0    47599
1.0    38037
3.0    23297
5.0    18000
6.0    14450
Name: market_id, dtype: int64
```

In [27]:

```
sns.set_style('darkgrid')
country = df['market_id'].value_counts().head(10)
fig, ax = plt.subplots(figsize=(10,7))
country.plot.bar(ax=ax)
```

Out[27]:

```
<AxesSubplot: >
```



```
Market 2.0 and 4.0 have the higher orders as compared to others.
```

In [157]:

```
df['created_at'] = pd.to_datetime(df['created_at'])
df['actual_delivery_time'] = pd.to_datetime(df['actual_delivery_time'])
```

# Filling Missing Values

In [158]:

```
cat_missing = ['market_id','order_protocol','total_onshift_partners',
              'total_busy_partners','total_outstanding_orders','actual_delivery_time']
most_freq_imputer = SimpleImputer(strategy='mean')
for col in cat_missing:
    df[col] = pd.DataFrame(most_freq_imputer.fit_transform(pd.DataFrame(df[col])))

df['actual_delivery_time'] = pd.to_datetime(df['actual_delivery_time'])
```

In [159]:

```
## Filling Categorical values
cat_missing = ['store_primary_category']
most_freq_imputer = SimpleImputer(strategy='most_frequent')
for col in cat_missing:
    df[col] = pd.DataFrame(most_freq_imputer.fit_transform(pd.DataFrame(df[col])))
```

In [160]:

```
df.head(2)
```

Out[160]:

| | market_id | created_at | actual_delivery_time | store_id | store_primary_category | order_protocol | total_items |
|---|---|---|---|---|---|---|---|
| **0** | 1.0 | 2015-02-06 22:24:17 | 2015-02-06 23:27:16 | df263d996281d984952c07998dc54358 | american | 1.0 | 4 |
| **1** | 2.0 | 2015-02-10 21:49:25 | 2015-02-10 22:56:29 | f0ade77b43923b38237db569b016ba25 | mexican | 2.0 | 1 |

In [141]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 197428 entries, 0 to 197427
Data columns (total 14 columns):
 #   Column                    Non-Null Count   Dtype         
---  ------                    --------------   -----         
 0   market_id                 197428 non-null  float64       
 1   created_at                197428 non-null  datetime64[ns]
 2   actual_delivery_time      197421 non-null  datetime64[ns]
 3   store_id                  197428 non-null  object        
 4   store_primary_category    197428 non-null  object        
 5   order_protocol            197428 non-null  float64       
 6   total_items               197428 non-null  int64         
 7   subtotal                  197428 non-null  int64         
 8   num_distinct_items        197428 non-null  int64         
 9   min_item_price            197428 non-null  int64         
 10  max_item_price            197428 non-null  int64         
 11  total_onshift_partners    197428 non-null  float64       
 12  total_busy_partners       197428 non-null  float64       
 13  total_outstanding_orders  197428 non-null  float64       
dtypes: datetime64[ns](2), float64(5), int64(5), object(2)
memory usage: 21.1+ MB
```

In [112]:

```
df.isna().sum()
```

Out[112]:

```
market_id                    0
created_at                   0
actual_delivery_time         7
store_id                     0
store_primary_category       0
order_protocol               0
total_items                  0
subtotal                     0
num_distinct_items           0
min_item_price               0
max_item_price               0
total_onshift_partners       0
total_busy_partners          0
total_outstanding_orders     0
dtype: int64
```

## Creating target feature (time)

In [161]:

```
# create a colume with timedelta as total minutes, as a float type
df['time'] = (df.actual_delivery_time  - df.created_at) / pd.Timedelta(minutes=1)
```

## Creating day of the week

In [162]:

```
df['day'] = df['created_at'].dt.day_name()
```

In [163]:

```
df.head()
```

Out[163]:

| | market_id | created_at | actual_delivery_time | store_id | store_primary_category | order_protocol | total_items |
|---|---|---|---|---|---|---|---|
| **0** | 1.0 | 2015-02-06 22:24:17 | 2015-02-06 23:27:16 | df263d996281d984952c07998dc54358 | american | 1.0 | 4 |
| **1** | 2.0 | 2015-02-10 21:49:25 | 2015-02-10 22:56:29 | f0ade77b43923b38237db569b016ba25 | mexican | 2.0 | 1 |
| **2** | 3.0 | 2015-01-22 20:39:28 | 2015-01-22 21:09:09 | f0ade77b43923b38237db569b016ba25 | american | 1.0 | 1 |
| **3** | 3.0 | 2015-02-03 21:21:45 | 2015-02-03 22:13:00 | f0ade77b43923b38237db569b016ba25 | american | 1.0 | 6 |
| **4** | 3.0 | 2015-02-15 02:40:36 | 2015-02-15 03:20:26 | f0ade77b43923b38237db569b016ba25 | american | 1.0 | 3 |

In [165]:

```
df.isna().sum()
```

Out[165]:

```
market_id                   0
created_at                  0
actual_delivery_time        0
store_id                    0
store_primary_category      0
order_protocol              0
total_items                 0
subtotal                    0
num_distinct_items          0
min_item_price              0
max_item_price              0
total_onshift_partners      0
total_busy_partners         0
total_outstanding_orders    0
time                        0
day                         0
dtype: int64
```

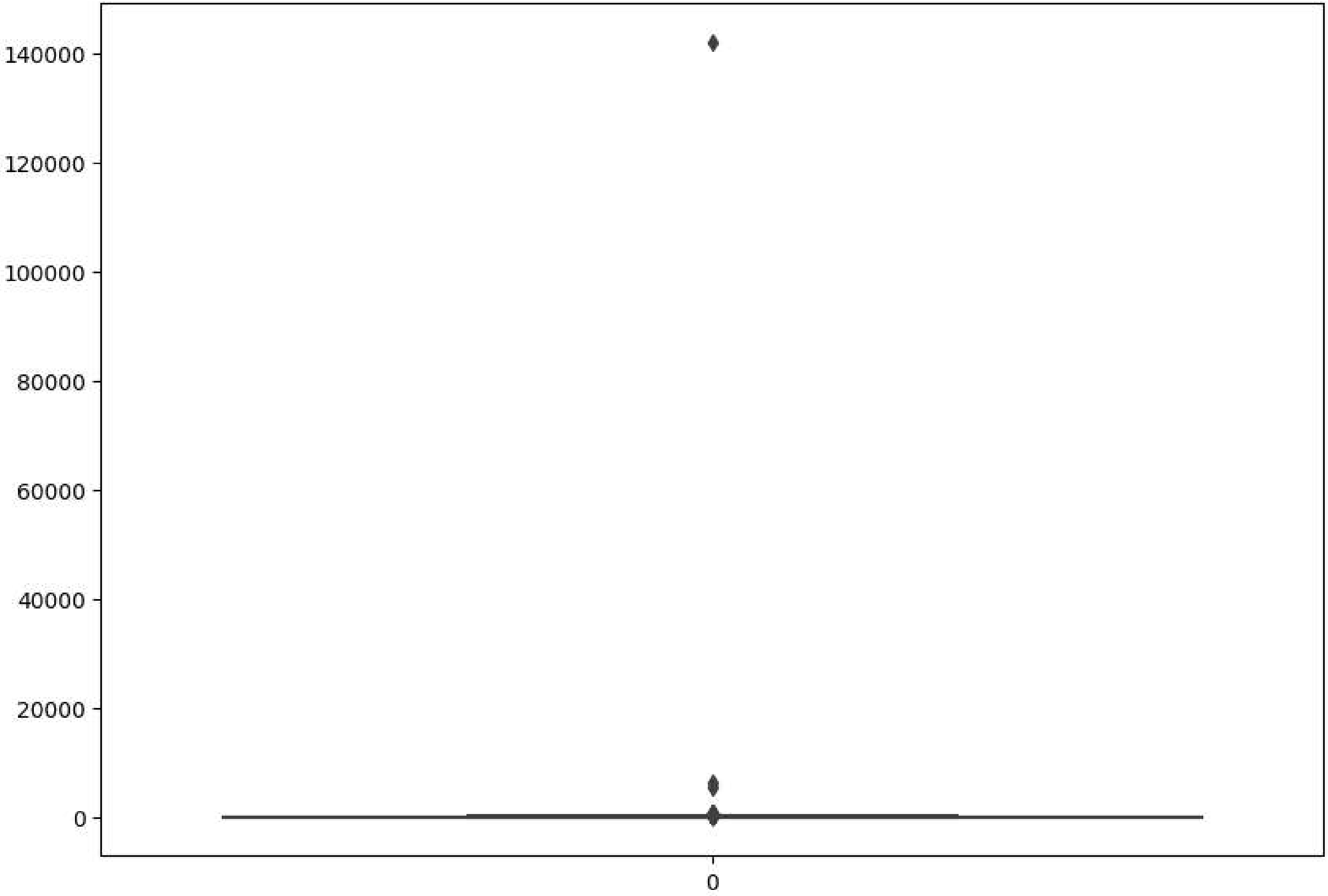
In [164]:

```
df.dropna(inplace=True)
```

## Checking Outliers

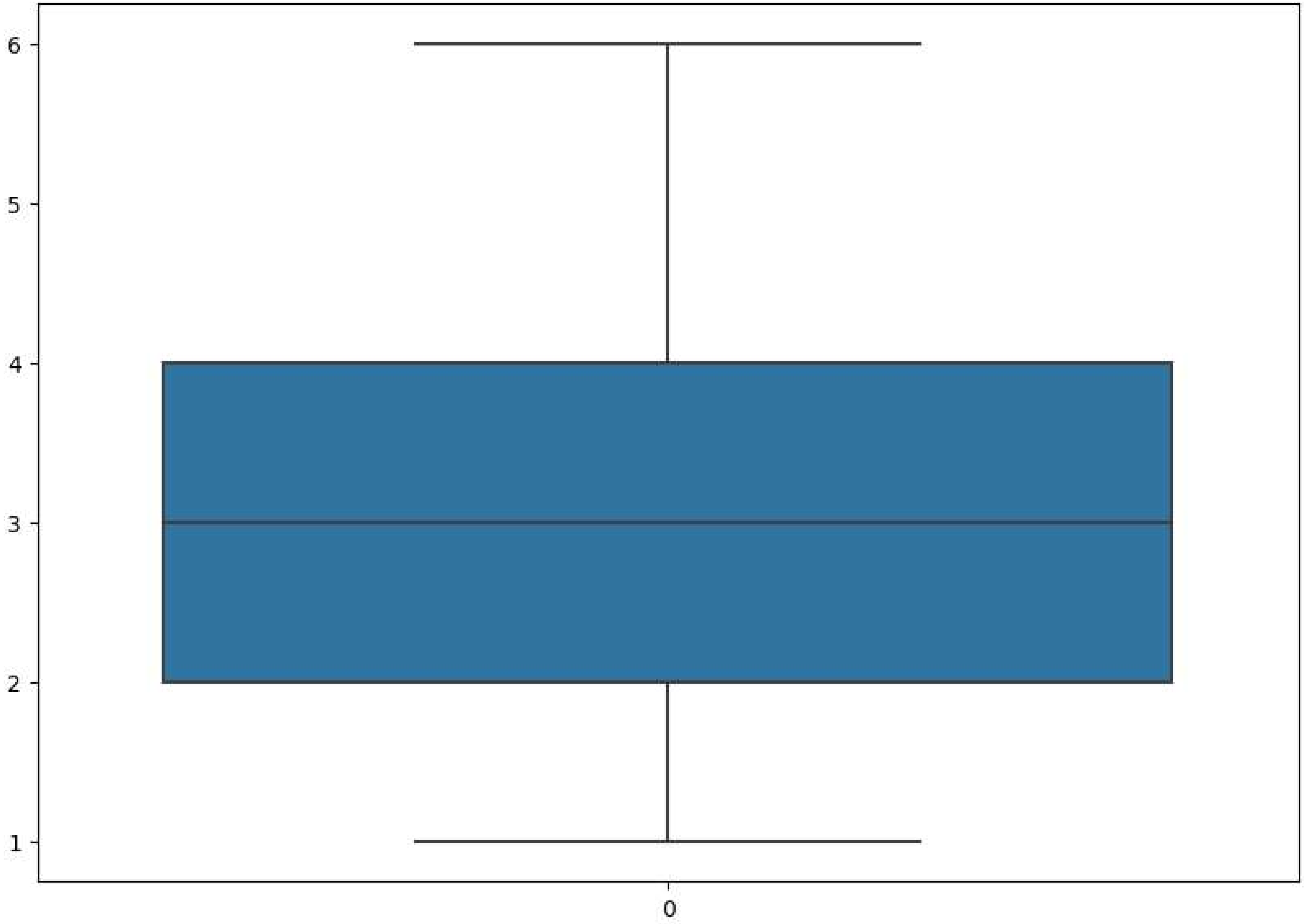
In [166]:

```python
fig, ax = plt.subplots(figsize=(10,7))
sns.boxplot(df['time'],ax=ax);
```



In [18]:

```
fig, ax = plt.subplots(figsize=(10,7))
sns.boxplot(df['market_id'],ax=ax);
```



In [20]:

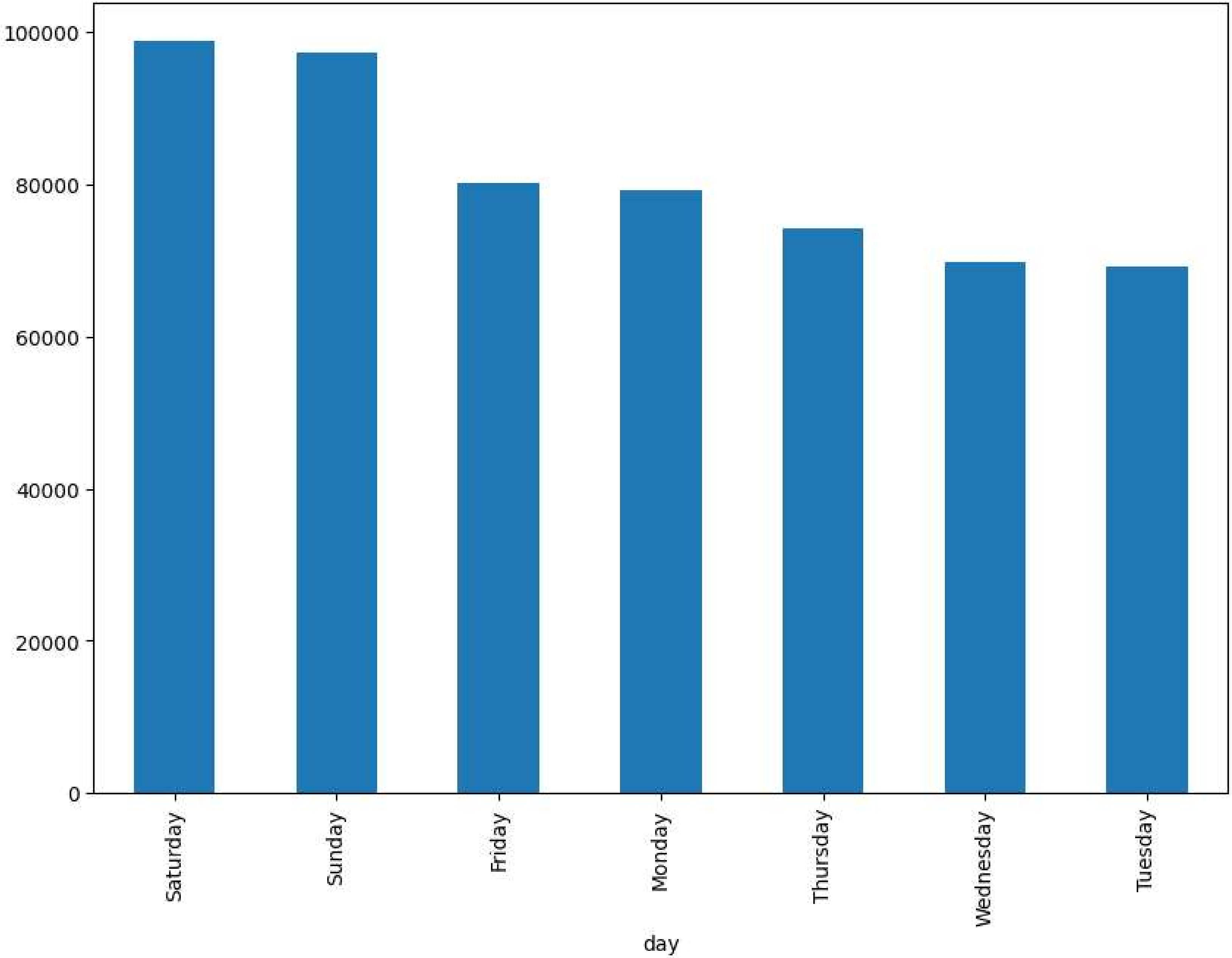
```
df.head(3)
```

Out[20]:

| | market_id | created_at | actual_delivery_time | store_id | store_primary_category | order_protocol | total_items |
|---|---|---|---|---|---|---|---|
| **0** | 1.0 | 2015-02-06 22:24:17 | 2015-02-06 23:27:16 | df263d996281d984952c07998dc54358 | american | 1.0 | 4 |
| **1** | 2.0 | 2015-02-10 21:49:25 | 2015-02-10 22:56:29 | f0ade77b43923b38237db569b016ba25 | mexican | 2.0 | 1 |
| **2** | 3.0 | 2015-01-22 20:39:28 | 2015-01-22 21:09:09 | f0ade77b43923b38237db569b016ba25 | american | 1.0 | 1 |

In [25]:

```
fig, ax = plt.subplots(figsize=(10,7))
df.groupby('day')['order_protocol'].sum().sort_values(ascending=False).head(10).plot.bar(ax=ax);
```



In [21]:

```
df['order_protocol'].value_counts()
```

Out[21]:

```
1.000000    54725
3.000000    53199
5.000000    44290
2.000000    24052
4.000000    19354
2.882352      995
6.000000      794
7.000000       19
Name: order_protocol, dtype: int64
```

In [26]:

```
# Identify number of categorical features
for d in df.columns:
    if(df[d].dtype == 'O'):
        print(d,': ', df[d].nunique())
```

```
store_id :  6743
store_primary_category :  74
day :  7
```

## Encode categorical fields as binary

In [169]:

```
# Encode categorical fields as binary
df = pd.get_dummies(df,sparse=False,columns=df.select_dtypes(include='object').columns)
```

In [168]:

```
df.columns
```

Out[168]:

```
Index(['market_id', 'created_at', 'actual_delivery_time', 'order_protocol',
       'total_items', 'subtotal', 'num_distinct_items', 'min_item_price',
       'max_item_price', 'total_onshift_partners',
       ...
       'store_primary_category_vegan', 'store_primary_category_vegetarian',
       'store_primary_category_vietnamese', 'day_Friday', 'day_Monday',
       'day_Saturday', 'day_Sunday', 'day_Thursday', 'day_Tuesday',
       'day_Wednesday'],
      dtype='object', length=6837)
```

In [170]:

```
df['created_at'] = pd.to_numeric(pd.to_datetime(df['created_at']))
df['actual_delivery_time'] = pd.to_numeric(pd.to_datetime(df['actual_delivery_time']))
```

In [172]:

```
df['created_at'] = np.asarray(df['created_at']).astype(dtype='uint8')
df['actual_delivery_time'] = np.asarray(df['actual_delivery_time']).astype(dtype='uint8')
```

In [174]:

```

X = df.drop('time',axis=1).values
y = df['time'].values

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)

print('Training data contains %.0f records'%len(X_train))
print('Test data contains %.0f records'%len(X_test))
```

## Data Scaling

In [175]:

```
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)

X_val = scaler.transform(X_val)
X_test = scaler.transform(X_test)
```

## fitting model on scaling data

In [ ]:

```
X_train = np.asarray(X_train).astype(dtype='uint8')
y_train = np.asarray(y_train).astype(dtype='uint8')

history = model.fit(X_train, y_train,validation_data=(X_val, y_test),epochs=10, batch_size=128)
```

# Creating model for Delivery Prediction

In [121]:

```
import tensorflow as tf
from tensorflow.keras import Sequential
from tensorflow.keras.layers import Dense
```

In [122]:

```
def create_baseline():
    model = Sequential([
                    Dense(64, activation="relu",kernel_initializer='glorot_uniform'),
                    Dense(32, activation="relu",kernel_initializer='glorot_uniform'),
                    Dense(16, activation="relu",kernel_initializer='glorot_uniform'),
                    Dense(8, activation="relu",kernel_initializer='glorot_uniform'),
                    Dense(1,activation='softmax')])
    return model
```

In [ ]:

In [123]:

```
model = create_baseline()
```

In [124]:

```
model.compile(optimizer = tf.keras.optimizers.Adam(),loss='mean_squared_error')
```

In [125]:

```
X_train = np.asarray(X_train).astype(dtype='uint8')
y_train = np.asarray(y_train).astype(dtype='uint8')
# X_train = np.zeros(X_train,dtype='uint8')
# y_train = np.zeros(y_train,dtype='uint8')
history = model.fit(X_train, y_train,validation_data=(X_test, y_test),epochs=10, batch_size=128)
```

```
C:\Users\ManishaGodse\AppData\Local\Temp\ipykernel_7060\2823625760.py:1: RuntimeWarning: invalid value enco
untered in cast
  X_train = np.asarray(X_train).astype(dtype='uint8')

Epoch 1/10
1034/1034 [==============================] - 14s 13ms/step - loss: 2465.4534 - val_loss: 3637.8640
Epoch 2/10
1034/1034 [==============================] - 11s 11ms/step - loss: 2465.4570 - val_loss: 3637.8640
Epoch 3/10
1034/1034 [==============================] - 11s 10ms/step - loss: 2465.4558 - val_loss: 3637.8640
Epoch 4/10
1034/1034 [==============================] - 11s 11ms/step - loss: 2465.4546 - val_loss: 3637.8640
Epoch 5/10
1034/1034 [==============================] - 12s 12ms/step - loss: 2465.4534 - val_loss: 3637.8640
Epoch 6/10
1034/1034 [==============================] - 15s 15ms/step - loss: 2465.4541 - val_loss: 3637.8640
Epoch 7/10
1034/1034 [==============================] - 12s 12ms/step - loss: 2465.4529 - val_loss: 3637.8640
Epoch 8/10
1034/1034 [==============================] - 10s 10ms/step - loss: 2465.4551 - val_loss: 3637.8640
Epoch 9/10
1034/1034 [==============================] - 10s 10ms/step - loss: 2465.4561 - val_loss: 3637.8640
Epoch 10/10
1034/1034 [==============================] - 10s 10ms/step - loss: 2465.4548 - val_loss: 3637.8640
```

In [127]:

```
train_pred = model.predict(X_train)
train_mse = mean_squared_error(train_pred,y_train)
print('Training RMSE is %.2f' % sqrt(train_mse))
```

```
4134/4134 [==============================] - 6s 1ms/step
Training RMSE is 49.65
```

In [128]:

```
test_pred = model.predict(X_test)
test_mse = mean_squared_error(test_pred, y_test)
print('Test RMSE is %.2f' % sqrt(test_mse))
```

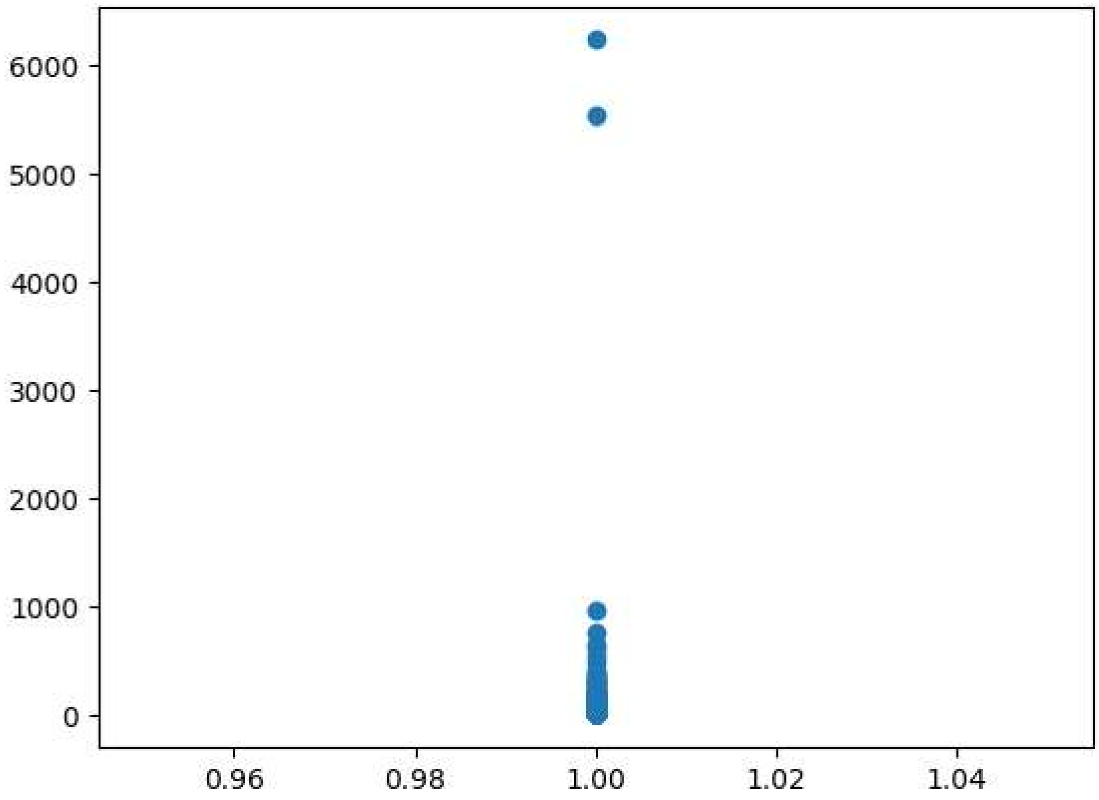
```
2036/2036 [==============================] - 3s 2ms/step
Test RMSE is 60.31
```

In [129]:

```
fig = plt.figure()
ax = plt.axes()
plt.scatter(test_pred,y_test)
```

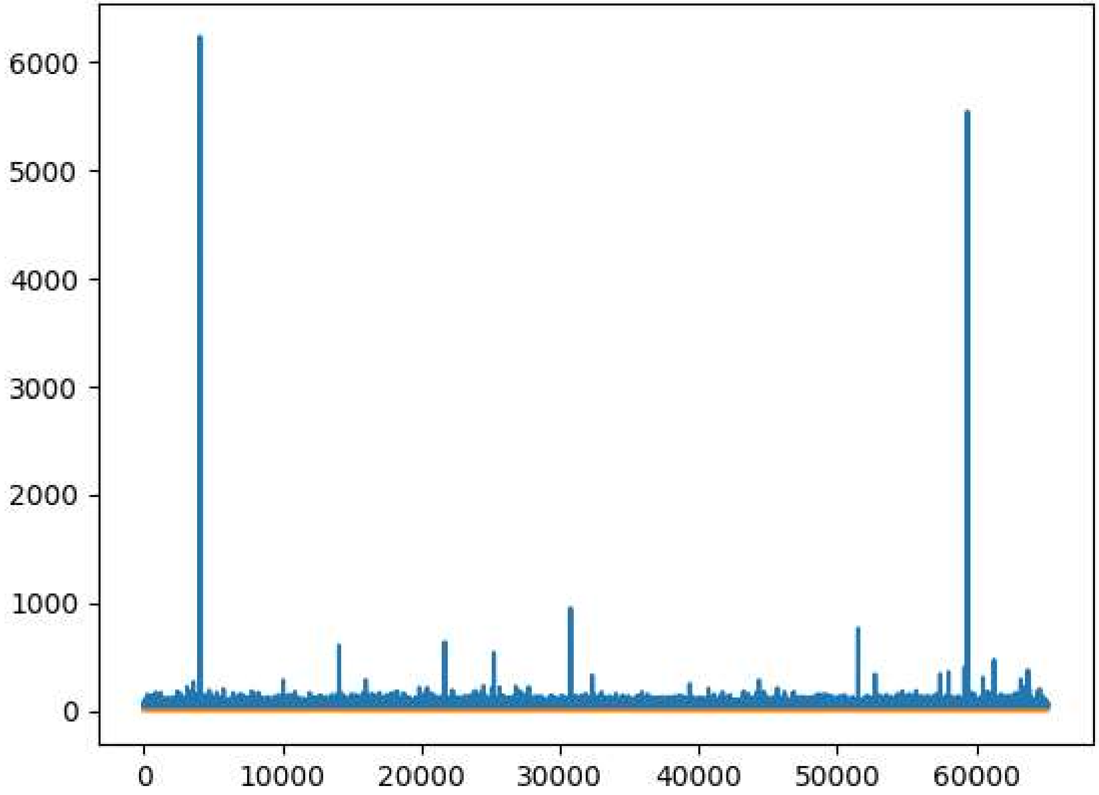
Out[129]:

```
<matplotlib.collections.PathCollection at 0x1cb214d61a0>
```



In [131]:

```
plt.plot(y_test)
plt.plot(test_pred)
plt.show()
```



In [ ]:

```
```

In [ ]:

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In [ ]:

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In [ ]:

```
```

In [ ]:

```
```